Q1. Answer all of the following questions.

(a) **[2 marks]** Give a counterexample to the following statement.

"*If a and b are integers with $a - b \geq 0$ and $b - a \geq 0$, then $a \neq b$.*"

(b) **[2 marks]** If $x \notin A \cup B$. Which of the following is true, $x \in A$ or $x \notin A$? Justify your answer.

Continue Q1 :

(c) **[4 marks]** Let $K = \{1, \{\varnothing\}\}$. Find $\mathcal{P}(K)$ and $|\mathcal{P}(\mathcal{P}(K))|$.

$\mathcal{P}(K) = \{$

$|\mathcal{P}(\mathcal{P}(K))| =$

(d) **[2 marks]** For all sets A, B, and C, draw Venn Diagram such that $A \subseteq C$, $B \subseteq C$, and $A \cap B \neq \varnothing$.

Q2. [**10 marks**] For any integers a and b, if $a^2 + b^2$ is divisible by 4, then either a is not odd or b is not odd.

Q3. Let $U = \{n \in \mathbf{Z} \mid -3 \leq n \leq 3\}$, $A_i = \{-i, i\}$. Find the following:

(a) **[2 marks]** $(A_1 \cup A_2) \cap \overline{A_3} =$ --

(b) **[4 marks]** Is $\{A_1, A_2, A_3\}$ a partition of U? Justify your answer.

Q4. **[10 marks]** For all sets A and B, prove that $(A - B) \cup (B - A) \cup (A \cap B) = A \cup B$.

